

# HAYNES® 230® Alloy

## For Long-Term Performance in Cyclone Separators

When vortex finder tubes and other internals in your cyclone separator aren't giving you the performance life you need to avoid costly downtime and replacements, turn to HAYNES® 230® alloy for the best in resistance to high-temperature warpage and oxidation damage. 230 alloy is suited for long-term continuous exposure at temperatures as high as 2100°F (1149°C). It is designed to outlast traditional stainless steels, nickel-chromium alloys, and iron-nickel-chromium materials by as much as 10 to 1! And, 230 alloy is both readily fabricable and repairable! Its retention of ductility after being in service for years means you can perform reforming and weld repair operations without any need for pre- or post-repair treatment. So consider HAYNES 230 alloy next time your plant is down for cyclone separator maintenance. It's the choice that will keep your plant up, and your maintenance costs down.

### Product Description:

HAYNES 230 alloy is a top-of-the-line high-performance, industrial heat-resistant alloy for applications demanding high strength as well as resistance to environment. It is a substantial upgrade in performance capabilities from common iron-nickel-chromium and nickel-chromium alloys, and displays the best combination of strength, stability, environment-resistance, and fabricability of any commercial nickel-base alloy. HAYNES 230 alloy can be utilized at temperatures as high as 2100°F (1150°C) for continuous service. Its resistance to oxidation, combustion environments and nitriding, recommends it highly for applications such as nitric acid catalyst grids, high-temperature bellows, industrial furnace fixtures and hardware, strand annealing tubes, thermocouple protection tubes, and many more.

### Resistance to High-Temperature Combustion Gas Environments\*

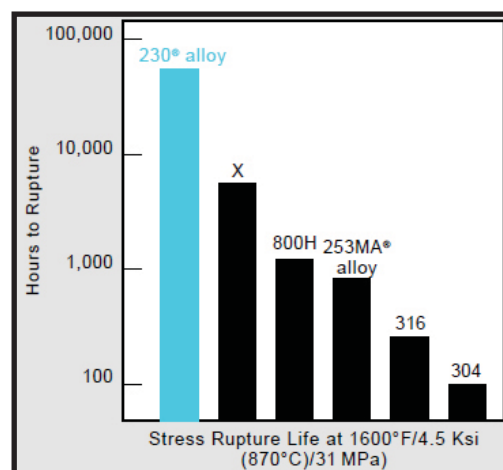
#### Maximum Metal Affected

Material	1800°F (980°C)		2000°F (1095°C)	
	1000 Hours		500 Hours	
	Mils	µm	Mils	µm
HAYNES® 230® alloy	3.5	89	5.7	145
HASTELLOY® X alloy	6.4	163	13.5	343
RA330 alloy	11.8	300	13.6	343
alloy 800H	15.3	389	27.2**	691**
Type 310	16.5	419	24.1	612
alloy 600	17.8	452	20.7	526
alloy 601	20.0	508	>24.0	>610
Type 304	>>23.0***	>>504***	-	-
Type 316	>>23.0***	>>504***	-	-

\* Samples exposed to product of combustion from burning a mixture of No. 1 and No. 2 fuel oils, and cycled to <500 F (280 C) every 1/2 hour.

\*\* Exposed only 400 hours

\*\*\* Exposed only 6.5 hours



### Chemistry: Weight %

Ni <sup>a</sup>	Co	Cr	Mo	W	Fe	Si	Mn	C	Al	B	La
57	5*	22	2	14	3*	0.4	0.5	0.10	0.3	0.015*	0.02
<sup>a</sup> As Balance		*Maximum									

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## Typical Tensile Properties (Plate):

Test Temperature		Ultimate Tensile Strength		0.2% Yield Strength		Elongation in 2 in (51mm)
°F	(°C)	Ksi	(MPa)	Ksi	(MPa)	%
Room	(Room)	125	(860)	57	(395)	50
1000	(540)	103	(705)	40	(275)	53
1200	(650)	98	(675)	40	(275)	55
1400	(760)	88	(605)	42	(275)	53
1600	(870)	63	(435)	37	(255)	65
1800	(980)	35	(240)	21	(145)	83
2000	(1095)	20	(140)	11	(76)	83
2100	(1150)	13	(91)	7	(47)	106
2200	(1205)	9	(65)	4	(30)	109

## Typical Rupture Properties (Plate):

Temperature		Typical Rupture Properties: Stress Required to Produce Rupture in Hours Shown, Ksi (MPa)					
°F	(°C)	100		1,000		10,000	
1200	(650)	56.0	(385)	42.5	(295)	29.0	(200)
1400	(760)	27.0	(185)	20.5	(121)	14.2	(98)
1600	(870)	13.7	(95)	9.5	(52)	6.2	(43)
1800	(980)	6.0	(41)	3.0	(21)	1.6	(11)
1900	(1040)	3.5	(24)	1.8	(12)	-	
2000	(1095)	2.1	(14)	1.0	(7)	-	
2100	(1150)	1.2	(8)	0.6	(4)	-	

## Typical Room Temperature Physical Properties:

	British Units	Metric Units
Density	0.324 lb/in <sup>3</sup>	8.97 g/cm <sup>3</sup>
Electrical Resistivity	49.2 µohm-in	125 µohm-cm
Dynamic Modulus of Elasticity	30.6 x 10 <sup>6</sup> psi	211 Gpa
Thermal Conductivity	62 Btu-in/ft <sup>2</sup> -hr-°F	8.9 W/m-K
Specific Heat	0.095 But/lb.-°F	397 J/Kg-K

## Environmental Resistance:

Oxidation in Air - Excellent at 2100°F (1150°C)

Sulfidation - Equal to X alloy

Carburization - Equal to X alloy

Nitriding - Best Commercial alloy

Chlorination - Equal to 625 alloy

Hydrogen Embrittlement - Not susceptible

*The data and information in this publication are based on work conducted principally by Haynes International, Inc. and are believed to be reliable. However, we do not make any warranty or assume any legal liability or responsibility for its accuracy, completeness, or usefulness. Nor do we represent that its use would not infringe upon private rights. Any suggestions as to uses and applications for specific alloys are opinions only and Haynes International, Inc. makes no warranty of results to be obtained in any particular situation.*

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